Information in maps: basic characteristics

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Information is the aggregate of sign contents or meanings which can be retrieved from a map. This study tentatively summarizes the basic characteristics of the information. Two broad topics are dealt with. The first, addressed in s. 2 (i.e., section 2), covers the conceptual modelling of the world by the map author. Relevant processes are the conceptualization of places and the alternative structuring of the global information. The second topic, developed in ss. 3-7, concerns several systematically important distinctions within the information; these are basic structural properties of map symbolism (the sign-system type which underlies mapping and map use). S. 3 introduces two high-order dichotomies: information about the mapped territory vs. peripheral meaning on the one hand and plan-related vs. plan-free information on the other. As shown in s. 4, many meaning units are present before expressions are assigned to them – they are present a priori –, while others are evoked by the expressive material. Related to this dichotomy is a distinction that pertains to expressions: they may be pre-empted for specific contents or else be abstract – i.e., not pre-assigned to contents –, so that they must be assigned through definitions. Further, evocation permits a map author to manipulate alternative notions or sets of notions and, within limits, to replace one conceptualization by another one (s. 5). S. 6 deals with the important dichotomy of immediate and implied meanings – or denotations and connotations. The former are coupled directly with perceivable items, the latter indirectly through other contents, by which they are implied. Peripheral meaning – already introduced in s. 3 – is considered in s. 7 and exemplified by style traits.

Keywords: information, conceptual modelling, information about the territory vs. peripheral meaning, plan-related vs. plan-free information, meaning as present a priori vs. evoked, immediate vs. implied meaning

1. Problem, programme, and terminology

The information found in a map is the aggregate of retrievable sign contents. It has met with little interest among cartographers, quite in contrast to the perceptual characteristics of cartographic representations. This is the more surprising as it shows some interesting structural phenomena which help to understand the nature of map symbolism, i.e., of the sign-system type on which mapping and map use are based. It is worth the effort to correct such an imbalance of interest.

This study, therefore, shall introduce the characteristics of the information found in maps. It does not deal with intricate details of semantic analysis but rather with basic issues. A programme of the discussion follows below. In some cases, information items from two different sources are manipulated in the same interpretation process, a fact which may be metaphorically called interpretation at two levels (ss. 4 and 6);¹ this matter has also been treated, in more detail than here, in an earlier study (Schlichtmann 2013). Finally, for the sake of brevity, we are limiting ourselves to maps in the traditional sense, although most points to be made will be applicable to other cartographic models as well.

¹ In cross-references, “s.” stands for "section" and “ss.” for "sections".
In this article, two broad topics are addressed: the conceptualization of the world (s. 2) and systematically important distinctions within the information universe (ss. 3-7). These distinctions come into view at various points in the study of map symbolism and can be seen as basic structural properties of this sign-system type. The familiar dichotomy of plan-related and plan-free information (introduced in s. 3) is one of them. In the interest of brevity, the discussion will cover only map symbolism as such. The handling of information in the processes of mapping and map use, by contrast, will be left aside; it would require a separate study.

The following basic terminology is used. According to the traditional continental-European sign conception, which has been adopted here, a sign has a conceptual and a perceptual component. The conceptual one is its content or meaning, the perceptual one its expression or sign vehicle or form. (Synonymous terms will hereafter be used interchangeably.) Contents will be cited in single quotation marks (‘mill’) and expressions between slashes (/square/). Expressions are coupled with contents through codes, i.e., sets of correlation rules. By means of signs we “talk” about states of the world – such as things, properties, and processes –, which are technically called referents. Further, “information” is used as a collective term for contents, as already noted. Also “meaning”, in the singular, is sometimes employed as a generic or collective term. For other background matters one might consult two comprehensive studies which are available online (Schlichtmann 2008a; 2009) or a recently published cartosemiotic dictionary (Schlichtmann 2011).

2. Conceptual modelling of the world

Referents are accessible to us through the concepts we have or develop of them; put differently, they are conceptualized or conceptually modelled. This process pertains to items – like ‘pond’ or ‘privately owned’ –, which then function as units of sign content, and to relations, which collectively make up the structure of an assemblage of such units. Information so defined may be distinct or fuzzy, although there is a tendency to conceive of objects and characteristics as distinct. Concepts may be taken over from ordinary or professional language or may be set up by the map maker. Finally, that we conceptualize facts does not imply that our conceptions could be wildly arbitrary. Rather, they must be sufficiently adequate to reality, otherwise they would be useless for orientation in the world.

Conceputalization of the world by map makers is an extensive topic and would merit a separate, more comprehensive study. Here we can only touch upon two issues: the modelling of places and their characteristics (s. 2.1) and alternative ways of segmenting and structuring the global information (s. 2.2). We shall conclude with two general points (s. 2.3).

2.1. Conceptualization of places

The concept of a mapped place is complex, informing about both the relevant segment of space and its characterizing traits. Both plan-related and plan-free information (see s. 3) are at issue. Often a place concept is taken from a store of previously-learnt notions, like ‘lake’, ‘Lake Huron’, or ‘municipality with 20,000 inhabitants’. In other cases, such a concept

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2 For one issue under this head, the assessment of the cartographic representation for factual fidelity, see Schlichtmann (1991, pp. 271-278; 2013, pp. 36-38).
3 We are referring to maps which have been created with the aim of representing the real world in a factually correct way. This is the most frequent aim of map-making.
4 By global information we mean an information complex in which units and their organization by relations have not been determined or, if they have been, are not taken into account.
is not readily available but must first be created. As an example, take ‘central business district (of city X)’. A central business district is characterized and delimited according to a specific mix and spatial arrangement of land uses, and different authorities have relied on somewhat different criteria; thus, a map author must be specific about both aspects, i.e., character and limits. For another example, imagine a fringe zone, in which a forest is expanding into pasture land. Here a cartographer may map a forest and a pasture area, separated by a distinct or fuzzy boundary, or he may recognize three areas: forest, grassland, and grassland-with-trees in between. At any rate, ideas about the relevant places must be available or developed (for further details see Schlichtmann 2011, pp. 81f.).

2.2. Alternative structuring of the global information

A map author starts out with a global information complex which is to be mapped. He may choose among different ways of segmenting the global information into units, of grouping the units, and of organizing them by relations. In other words, there are alternative ways of conceptual modelling. To exemplify by a familiar situation: quantitative values are often grouped into numerical ranges – cartographers tend to call them classes, and these can be delimited by various criteria, among which, in each case, one must be chosen. The criteria of range definition have been widely discussed in the literature about choropleth maps (see, e.g., Coulson 1987 and the literature cited there). Other procedures of alternative structuring are variation in the depth of conceptual hierarchies and one-to-one matching with replacement (Schlichtmann 2004, pp. 30-32); the latter is also exemplified below in s. 5.2.

2.3. General points

In conclusion, two general points are worth remembering. First, the choice among conceptual models is obviously not arbitrary but depends on what the map compiler wants to demonstrate or to find out. Nevertheless – and this is the second point –, the information is, to some extent, not simply given but, within limits, actively shaped or constructed. This fact calls attention to the cognitive, knowledge-organizing function of mapping, that is, its function of constructing conceptual models of segments of reality.

3. Distinctions within the information

Information found in maps can be subdivided and classified from various points of view. For example, we can recognize many thematic categories, but this is a matter of detail and thus not of interest in the present context. We rather must look for distinctions which are pervasive and independent of specific themes. They can be seen as basic structural properties of map symbolism.

At the most general level, we can distinguish information about the mapped territory and peripheral meaning – or peripheral information. The territory shown in a map is an aggregate of places along with their characteristics (Schlichtmann 2011, p. 101). Information about the territory needs no further comment; it is the raison d’être of any map. Peripheral meaning relates to the functional contexts of a cartographic representation (ibid., pp. 44f.). Among the context factors we recognize, first, the identity of territory, map author, and prospective audience, expressed in map title, credit note, and, if required, other marginal

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5 It would be interesting to analyze compilation instructions of map series when studying the shaping of concepts and their application to facts in the world.

6 Also called cartographic information (Koláčný 1969; Neumann (ed.) 1997, entry 444.0).
entries. Other such factors are, for example, the map author’s ways of thinking and mapping, the supposed expectations of the intended audience, and the intellectual or political mental “climate” of the time of mapping. Facets of this assemblage are peripheral to, or superimposed on, the information about the territory and are thus collectively called peripheral meaning. They will be are considered in s. 7.

From a different point of view, one can recognize object information and meta-information (Schlichtmann 2011, p. 75). Object information is information about the objects under discussion. In maps and other cartographic models, such objects are, first and foremost, the mapped places, although the term also applies to entities like author and audience. Since meta-information, applied to the entries in the map face, also relates to processes of map making and hence to the context in which the said entries stand, it is tentatively taken to be a kind of peripheral meaning.

At a more analytical level, we concentrate on information pertaining to the territory. Intuitively, there are two ways to decompose the information. First, one recognizes spatial, temporal, and substantive components. This approach is convenient and useful in some situations. Second, one distinguishes plan information (or plan-related information) and plan-free information. The last-mentioned distinction has proven to be most useful in the study of maps and other representations on a horizontal plane. Plan information encompasses all concepts of plan-related characteristics of mapped places and of motions between or within such places. Its categories are more or less ubiquitous and make up a closed class. The categories of the plan-free information (pertaining to landforms, water bodies, roads, traffic on roads, etc.) form an open class from which, for each map, the relevant ones are selected.

Finally, when signification processes are studied in detail, two other systematically important distinctions come into view. First, one must separate information existing before expressions are assigned to it from contents that are evoked by their expressions. Second, immediate and implied (mediated) meanings are to be kept apart. These issues are considered in ss. 4–6.

4. Meaning: present a priori or evoked

In the simplest situation, sign production proceeds as follows: a map author identifies a specific content – for example, ‘mill’ – and afterwards fits a perceivable entry to it – e.g., /square/ –, which then serves as its expression. Here meanings are present a priori. In other cases, however, meanings are evoked by the expressive entries, after these have been entered into the map face (see also Schlichtmann 2011, p. 37). That is, an expression is already endowed with a meaning. Two simple examples: a pictogram /horse/ evokes ‘horse’, and a series of tones (darkness values), inherent in marks which are otherwise alike, suggests that a set of contents is ranked according to some criterion. As can be seen, the phenomenon of evocation may pertain to items or to relations. It is most obvious with iconic entries – as exemplified – but also occurs, more or less pervasively, in the absence of iconicity, if the underlying code is already firmly accepted before mapping. Examples are written entries and emblems of automobile brands in a map of car dealerships.

If we now shift our interest from meanings as such to the ways in which expression items get coupled with meanings, an interesting correlation emerges. Where contents are evoked, expressions are pre-empted for the conveyance of these contents, as is the case with plan views of objects. As noted above, the signs involved may or may not be iconic. Where meanings are present a priori, the perceivable entries are abstract in the sense that they are

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7 For cartographic models other than maps, other distinctions may be appropriate.
8 Or at least with a core of meaning which can be further elaborated.
not pre-assigned to contents. Examples are the so-called geometric symbols. Here the links between expressions and contents must be explicitly introduced, most often by a legend. Admittedly, the boundary between the two kinds of entries is not always sharp. Further, it can be crossed in one or the other direction, as it is when meanings of pictograms are replaced (s. 5.1) or in symbol standardization. In the latter case, the transcription of specific information items by specific abstract means has become habitual, as we may observe in meteorological charts.

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**Figure 1:** Farms by size groups in southeastern Saskatchewan, by census subdivisions, 1966. From Schlichtmann (1972, p. 325).

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* Sometimes it is doubtful whether a symbol trait should be evaluated as pre-empted or abstract; an example is the green colour indicating forest in topographic maps. Generally speaking, there are borderline cases, and these are usually difficult to place into specific classes. Where there is doubt about such a placement, it is preferable to err on the side of caution and to consider the relevant means of expression to be abstract.

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Two additional remarks may be helpful. First, evocation may be put to service in discovering new information. Let a map show the distribution of farms for rural districts by means of column diagrams (figure 1). The relative position of a column corresponds to the range – or class – of farm sizes, and its length stands for the number of farms in a given range. The columns are combined in a compound figure, which gives rise to a silhouette; the latter carries two meaningful traits engendered by the said combination: shape and size. Shape stands for the distribution of farms over size ranges – e.g., small farms dominant, distribution balanced, large farms dominant –, and size indicates the total number of farms – even though the irregular shapes only permit to make more-less comparisons. Through the combination, then, information is evoked which previously was not available in the raw data and was not consciously put into the map.

Second, in landform mapping, some techniques aim, in the first place, at evoking an image of the relief (for details see Schlichtmann 2003, pp. 56f.). Only in the second place, or not at all, are they geared to recording elevations, gradients, or shapes of objects. Among the relevant procedures, the most familiar one is hill-shading.

5. Taking account of two conceptualizations at the same time

At this place we can present an interesting addition to the preceding section. In some situations alternative concepts, or alternative sets of concepts, are present at the same time, and one conceptualization replaces the other. Such replacements occur within relatively narrow limits. In all cases evocation plays a role. Content terms involved in replacement processes may be seen in isolation (s. 5.1) or are organized in files (s. 5.2).

5.1. Content terms seen in isolation

As noted in s. 4, the pictogram /horse/ means ‘horse’ by virtue of evocation. If it is to serve as a map symbol, it usually is made to mean something different, e.g., ‘stud farm’. That is, an intended content is introduced through the legend and coupled with the existing symbol; it replaces or supersedes the original meaning, although the latter remains accessible in the background. Now, a visual characteristic which evokes a content can be very suggestive. If one employs it and a content item is evoked, the item that is intended to be expressed should be identical with the evoked one, or both should at least be closely related, so that map users can easily re-think the underlying transfer. For example, if the said horse figurine does not mean ‘horse’, it should nevertheless convey some notion which is related to ‘horse’, such as ‘racetrack’ or ‘horse-breeding industry’,10 but certainly not ‘airport’. An analogous reasoning applies to relations. Thus, as tones in a series stand in the relation /darker than/, i.e., as they are ranked, the set of concepts which the tones express shall also be ranked and not just different.11 On the other hand, if intended and evoked content components are not identical or closely related, the evoked one still tends to dominate in the reader’s mind, may cause confusion, and must be superseded at the expense of additional interpretation effort.

5.2. Content terms organized in files

In the second place we shall consider the correspondence between content terms organized in files and the subsequent replacement of one set of terms by the other. A file or

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10 The underlying relations between ‘horse’ and ‘racetrack’, ‘stud farm’, or ‘horse-breeding industry’ are metonymies; they are frequent where meanings of pictograms are replaced.

11 This case exemplifies the principle of homological transcription, by virtue of which relations holding between contents are reproduced by corresponding relations between expressions (Schlichtmann 2011, p. 51).
commonality class is a set of terms which have a characteristic in common and are organized by one or more specific relations (Schlichtmann 2004, pp. 22f.; 2011, pp. 40-42).

Table 1 shows a file of content units and one of expression units. Standard scores resulting from a principal-components analysis are grouped into ranges; these, in turn, are transcribed by tones in a choropleth map. According to the legend glosses (left-hand column), these ranges make up a bipolar series – one with positive and negative values –, but the transcription in the map face, introduced by the specimen symbols in the legend (right-hand column), evokes a unipolar series.

Table 1: Numerical ranges (standard scores resulting from a principal-components analysis) and corresponding tones in a choropleth map of Winnipeg, Canada (Nicholson & Yeates 1969, p. 169). The reference areas are census tracts, the smallest urban units for which Canadian census data are reported. The ranges in the left-hand column should, of course, have been defined without overlap. Redrawn after Schlichtmann (2004, p. 31)

<table>
<thead>
<tr>
<th>Scores according to the legend glosses</th>
<th>Grey tones of the specimen symbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 3</td>
<td>6 (darkest)</td>
</tr>
<tr>
<td>1 to 2</td>
<td>5</td>
</tr>
<tr>
<td>0 to 1</td>
<td>4</td>
</tr>
<tr>
<td>0 to -1</td>
<td>3</td>
</tr>
<tr>
<td>-1 to -2</td>
<td>2</td>
</tr>
<tr>
<td>-2 to -3</td>
<td>1 (lightest)</td>
</tr>
</tbody>
</table>

Consequently, the table permits to compare two ways of structuring the information, one underlying the legend glosses, the other evoked by the grey tones. Intuitively both make sense. Legend glosses and transcription are based on different models of a structured set of content units –or content models for short. These have first been matched term-by-term, and afterwards one set has been replaced by the other. That is, we have a one-to-one matching with replacement or exchange (Schlichtmann 2011, pp. 65f.). The matching is ultimately based on a relation of equivalence between corresponding terms, which does not hold between concepts as seen in isolation but – this is important – between concepts taken as members of files.

Such one-to-one matching with subsequent replacement is surprisingly frequent in thematic cartography and is applied for different reasons. In the present case the reason was probably a matter of graphics: a unipolar series is easier to transcribe in black and white than a bipolar one. The matching-with-replacement procedure is acceptable so long as the two content models involved can be reconciled, even though this process requires additional interpretation effort.

12 Put differently, the cartographer has set up two alternative cognitive elaborations and shifted from one to the other while making the map.

13 Whether or not this relation has been present in the map maker’s mind is, in principle, irrelevant. The important point, supported by experience, is this: in many cases a map user can plausibly reconstruct, or at least construct, the transfer from one organized set of contents to the other. This suggests the presence of a powerful equivalence relation.
6. Meaning: immediate or implied (denotation or connotation)

Expressions may be linked to content units either directly or else indirectly through the mediation of other contents. Let a map show a reservoir of water, created by damming up a valley. The appropriate symbol, which has a familiar tapering shape, expresses ‘reservoir’ or some equivalent concept. This content is directly coupled with the mark; it is its direct or immediate meaning. Now, ‘reservoir’ conventionally, or customarily, calls to mind concepts like ‘water supply’, ‘flood control’ and ‘power generation’, since water supply, etc. are the usual purposes for which reservoirs are built. Put differently, the aforementioned concepts are conventionally implied by, or associated with, the meaning ‘reservoir’. They are not directly coupled with the perceivable entry but are only indirectly accessible through the mediation of ‘reservoir’. To sum up: part of the retrieved contents are mediated by more basic ones, which, in their turn, may be immediate or implied. Details of this process of mediation need not detain us.

Implication reflects a more general phenomenon: the organization of sign contents by relations. Implied meanings may be taken from the store of the concepts laid down in a sign system or be based on knowledge about the world (like ‘water supply’ above). In the latter case, they may originate from knowledge about the mapped place or about one or more places in its vicinity (see Schlichtmann 1979, pp. 88-93).

Immediate and implied meanings are often called, respectively, denotations and connotations – or denotative and connotative meanings. These traditional terms have been subject to much critical discussion, in particular because either one has different senses. This is why, up to now, neutral designations have been used. In any case, however, it is necessary to keep apart immediate and implied (mediated) meanings. Further, the traditional terms, if understood as they are here, continue to be serviceable, for they are relatively short and in wide use. They will occasionally be employed below, even though not all terminological issues are resolved.

Implied meanings, far from being potentially interesting side issues, play a great role in map interpretation (ibid.). Although they range from widely shared to idiosyncratic, it is the more or less conventional ones which are of theoretical and practical importance. That is, they are normally accessible to us by virtue of socially shared rules. They are not usually products of a map user’s free imagination, contrary to certain claims made in the literature (Edney 2005, p. 79). If they were, one could not understand how several readers could retrieve identical or similar connotations.

7. Peripheral meaning

The dichotomy of information about the mapped territory and peripheral meaning has been introduced above (s. 3). While the preceding text concerns mostly the former, the present section is devoted to the latter. The territory-related information is almost completely retrieved through the map face. Entries expressing peripheral meaning may be encountered within or outside the map face; in what follows we shall consider only what is found in the map face.

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14 Here we are following a traditional view as developed by Eco (1976, pp. 54-57) and applied in cartography by Schlichtmann (1979).

15 The different senses – and the underlying conceptions – are presented by Sonesson (1998; 2011, ss. 5.1, 5.2). For other debatable points see also Schlichtmann (2011, p. 35).
Peripheral meaning may be distinct or vague. There are several kinds; some have been recognized, and others remain to be discovered. Well-recognized are style and socio-political evaluation of the world – elsewhere called ideology (Schlichtmann 2008b). Here we may also include meta-information, i.e., contents relating to the information about the territory and about its representation (Schlichtmann 2011, p. 75). Units of peripheral meaning may be denotative or connotative.

By way of example, we add a few notes on style. In cartosemiotics, a style may be defined, first, as one way among others of presenting information about a territory which leaves this information substantially unchanged and, second, as the set of traits which are characteristic of this way of presenting information. The concept of style is applicable to both expressions and contents. Large-scale topographic maps of Belgium and the Netherlands show rather wide road symbols, comparable maps of the United Kingdom – especially the old 1-inch-to-1-mile series – relatively narrow ones. These are style traits relating to expressions. Further, in the topographic 1:50,000 series of the Netherlands many land use and land cover types are distinguished, in comparable Canadian maps only a few. These are stylistic characteristics that relate to contents.

Style traits release connotations which point back to the originator(s) of the representation. Such characteristics may inform not only about an individual map compiler, but also about institutional map producers and the environments in which they operate or operated. So, many maps found in older issues of the journal “The Geographical Review” exhibit a distinct institutional style, manifested in recurrent traits of typography, graticule entries, and depiction of the sea (examples in Leighton 1966, pp. 156f., 166). Connotations of style may also call to mind a national mapping tradition, a point that is familiar from atlases and topographic map series.

8. Summary and concluding notes

The preceding discussion was an attempt to make explicit the basic characteristics of the information provided in maps. Two broad topics were dealt with. The first covered the conceptual modelling of the world by the map author (s. 2). It was exemplified by the conceptualization of places and the alternative structuring of the global information. The second topic, developed in ss. 3-7, concerned several systematically important distinctions within the information. These are basic structural properties of map symbolism. In s. 3, two high-order dichotomies were introduced: information about the mapped territory vs. peripheral meaning on the one hand and plan-related vs. plan-free information on the other. As shown in s. 4, many meaning units are present before expressions are assigned to them – they are present a priori –, while others are evoked by the expressive material. Related to this dichotomy is a distinction that pertains to expressions: they may be pre-empted for specific contents or else be abstract – i.e., not pre-assigned to contents –, so that they must be assigned through definitions. Further, evocation permits a map author to manipulate alternative notions or sets of notions and, within limits, to replace one conceptualization by another one (s. 5). S. 6 dealt with the important dichotomy of immediate and implied meanings – or denotations and connotations. The former are

16 In recent years, research on style has become popular among cartographers, although it has not necessarily been done under the umbrella of semiotics. As examples (with further literature) consider studies by Kent (2009) and by Ory et al. (2013).
17 The expressions of style etc. are typically scattered across the map face and are not explicitly introduced, while meta-information is conveyed by well-explained entries in the map face or entries in the marginal notes.
coupled directly with perceivable items, the latter indirectly through other contents, by which they are implied. Peripheral meaning – already introduced in s. 3 – was considered in s. 7 and exemplified by style traits.

Finally, two general points are worth remembering. First, signs exist so that we can convey and manipulate information, i.e., meanings. The latter are the core of semiotics and its subfields, and, by implication, deserve to be studied. Such research, applied to cartosemiotics, helped to discover some interesting structural traits, as shown above. Second, several phenomena covered in this article relate to conceptual modelling. They remind us of the cognitive, knowledge-organizing function of the cartographic representation.

9. References


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